The Federal Government as a Catalyst for Market Change: A Compressed Air System Market Case Study

A CASE STUDY

by

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Submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
in Business and Policy

State University of New York
Empire State College
1998

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ABSTRACT

This case study presents a case for constructive intervention of the federal government in markets as a mechanism for encouraging actions that have a public benefit. The example given uses a business model to create an attractive environment for utilities, industrial end-user companies, equipment manufacturers and suppliers, and other stakeholders to voluntarily pool resources and work cooperatively to change the market for efficient and effective industrial compressed air systems. This collaborative project, now underway, is called the "Compressed Air Challenge."

Policy decisions concerning how when it is appropriate for the federal government to intervene in a particular market can have significant impacts on our daily lives. A wide array of intervention techniques, both regulatory and persuasive, have been and continue to be used by the federal government to shape everything from real estate investments to food safety. I present a different concept of a persuasive market intervention, one that relies primarily on establishing an environment that encourages the participants within an existing market structure to interact with other in new ways. This type of intervention focuses on affecting *institutional and behavioral change*, rather than a focus on *technological change* more typical of market interventions to promote energy efficiency.

The case study presentation includes the following elements:

- an historical overview of the role of the federal government as an intervener in US markets, including for energy efficiency;
- an investigation of the role of the sustainable development in motivating industrial end users to participate in the Compressed Air Challenge;
- a discussion of utility restructuring and its impact on relationships with industrial customers and the compressed air industry;
- an overview of the current status of compressed air industry, with particular attention to the factors that make this industry especially suited for a market-based intervention;
- a description of the origins, goals, objectives, and current status of the Compressed Air Challenge, and
- an examination of the potential for using the policy model presented in this case study in other market interventions. This includes identification of the key elements to consider in selecting a potential target market.

The case study concludes with the argument that this type of intervention is an extremely cost-effective way for the federal government to effect lasting change within markets, because shifts in behavior create a dynamic that will provide for continued change long after

the initial intervention has been completed. It is also an approach that is sustainable because it respects the workings of the marketplace.

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1.0 Introduction

Policy decisions concerning how and when it is appropriate for the federal government to intervene in a particular market can have significant impacts on our daily lives. A wide array of intervention techniques have been and continue to be used by the federal government to shape everything from real estate investments to food safety. These interventions include both directed actions, such as regulations, and persuasive actions, such as tax incentives. While actions such as regulations are a very powerful tool for effecting change, they can be difficult and costly for business to implement. Moreover, they can result in unintended consequences as market forces respond in ways that challenge the flexibility of regulations.

In recent years, I have become intrigued with the different concept of a persuasive market intervention, one that relies primarily on establishing an environment that encourages the actors within an existing market structure to interact with each other in new ways. In particular, I am interested in examining how such interventions can be used to promote energy efficiency in industrial settings. It is my contention that providing a environment for these new interactions to occur can create significant new business opportunities that result in a permanent transformation of an existing market from the inside out. This type of intervention focuses on effecting *institutional and behavioral change*, rather than a focus on the *technological change* more typical in market interventions to promote energy efficiency. My assumption is that the structural shifts resulting from institutional or behavioral change will create a more fertile environment for technological innovation. For lack of a better term, I will refer to this approach as *collaborative intervention*.

Collaborative intervention places government in the role of a broker or facilitator responsible for setting out general goals, inviting market participants to identify themselves as champions, recognizing them for the risk assumed in becoming champions, and then helping them to identify possible paths for reaching those goals. In doing so, this approach seeks to exploit to maximum benefit the different, and potentially complementary roles and competencies of the public, private, and not-for-profit sectors. I have identified four key preconditions for this approach: acknowledgment and acceptance that the participants will act in ways that are consistent with their economic and political self-interest; an atmosphere of mutual respect among participants; a broad definition of goals with no predetermined way of achieving them; and a high tolerance for the ambiguity and tension involved in forming coalitions that cut across typical market structures.

To illustrate this approach, I will present a case study of collaborative intervention by the federal government, still underway, that seeks to foster a transformation of the customer and supplier relationship for industrial compressed air systems. This collaborative intervention, which will be referenced by its working title the “Compressed Air Challenge: Resources for System Optimization” or the “Challenge”, is unique in its use of a business model to solicit interest and funds for its implementation. I will examine the extent to which this model has contributed to the success of the Challenge. This case study will also include a discussion of some of the organizational dynamics already evident in the early stages of project

development.

To provide context, I will provide an overview of the role of the federal government as an intervener in US markets, including a brief examination of historical context and recent challenges to federal invention. Particular attention will be given to energy efficiency, including examples of current and past efforts to transform markets to promote energy efficiency. The purpose of this discussion is to argue the case for federal intervention to promote voluntary approaches to energy efficiency.

Since industrial users of compressed air systems are the target market for effecting long-term change, an analysis of the motivation and interest of US industry in sustainable development is included. While the ultimate response of these "end users companies" to the Compressed Air Challenge will occur outside of the time period included in this case study, their initial willingness to participate can be linked to corporate goals that are attributable, either directly or indirectly, to increased awareness of the profitability embedded in such sustainable development strategies as industrial efficiency and waste reduction.

No examination of the compressed air market would be complete without a discussion of utility restructuring. The electric utility industry is undergoing a massive transformation from de jure franchise monopolies to greater competition. As the result of this transformation, utilities are beginning to look at their customer relationships in different ways. Retention of industrial customers has become a primary focus; one strategy for retaining customers is the provision of new services. The energy service companies that are evolving from the regulated utilities are experimenting with a full-service approach that includes providing customers with compressed air, rather than only providing electricity.

After laying the groundwork for federal, industrial, and utility involvement, I will provide an overview of the current status of the compressed air industry. Particular attention will be given to the factors that make this industry especially suited for a collaborative intervention. Topics will include: market structures, customer interactions, system improvement opportunities, and barriers to achieving those opportunities. The issue of whether this market is capable of transforming itself without government intervention will be addressed.

A case study, the Compressed Air Challenge, will be presented as an illustration of a collaborative intervention. The case study will include an analysis of the history, goals, and objectives of the Challenge, the target market; possible outcomes; champions; progress to date; barriers; how effectiveness will be measured; what factors will likely contribute to its success. Its likely impact on the industrial compressed air market will be discussed, including potential changes outside of the stated goals of the project.

Finally, I will examine the potential for using the policy model developed for the Compressed Air Challenge in other market interventions. This will include identification of the key elements to consider in selecting a potential target market. A brief analysis of further development and testing opportunities will also be presented.

2.0 The Role of the Federal Government in US markets

Market structures in the US economy generally work well. Our economy is the source of our political strength as the sole remaining "super-power" and is the subject of emulation and envy for much of the developing world. Products and services are constantly being created to meet perceived customer needs. Whether new products and services are successful and whether they displace existing products and services is driven primarily by how well they find their target market. Our economy is frequently described as a "free" market- meaning a capitalistic environment comprised of the actions and reactions of buyers and sellers, largely without restrictions.

This isn't entirely true. Our markets operate in an environment of subsidies, regulations, and protective structures that represent long-term efforts, not always successful, to use the power of federal, state, and local government to balance private profit and the public good. It is my contention that there is an ongoing role for the federal government in helping to shape markets to better represent the public good, without taking a "command-control" approach. I believe that it is possible to respect and work with existing market structures while acting as a catalyst to achieve changes that a market, particularly a very mature one, may be unable to accomplish on its own.

2.1 The Federal Role

The federal government has always had a role in US markets. In actuality it has had many roles, including: investor, protector, regulator, and consumer. There are many historical examples of federal intervention in markets, even during periods widely viewed as relatively untrammeled by government regulation. Public/private cooperative investment for the common good was occurring at a substantial scale in this country as early as the 1820s, when $125 million of combined private and public funds was spent for the construction of the canal system (Heilbroner 1984, 94-95). Substantial public funding has been invested over the years to create a public infrastructure of railroads, highways, airports, and utilities.

Since the earliest days of our nation, the federal government has intervened in matters of trade to protect nascent or strategically important domestic industries from foreign competition via tariffs, production subsidies, and import quotas. While many of these protections are giving way in the movement toward more global markets, the federal government continues to be centrally responsible for negotiating agreements such as the North American Free Trade Agreement (NAFTA) and the Global Agreement on Tariffs and Trade (GATT) and the ensuing World Trade Organization (WTO). Federal subsidies on commodities such as sugar, petroleum, and peanuts continue at this writing.

Federal purchases and the drive for innovation during times of war have changed the direction of entire industries. Even during the current period, the federal government is the world's largest customer, purchasing in excess of $70 billion in non-weapon-related supplies and equipment (McKane, et al 1995,2).

The federal government has tremendous potential to affect markets and has provided leadership in many markets, including aerospace and computer technology. Like most large institutions, however, it has not always been a wise investor or purchaser. Long before the public outcry over $600 toilet seats, the federal government "was billed at three times the actual cost by the first transcontinental railway construction company, whose expenses Congress had agreed to underwrite"; the company later burned its books when questions began to surface (Heilbroner and Singer 1984, 152-3). Fiscal oversight has always been a key concern for appropriate federal investment.

The federal government began to formally regulate markets with the creation of the Interstate Commerce Commission (ICC), established in 1887 to regulate rates on interstate rail transportation in response to public outrage over excessive freight rates. The volume of federal regulations mushroomed between the 1960s and 1980s, particularly in response to concerns about the environment, growing from 10,000 pages a year to a peak in 1980 at 87,000 pages and leveling out by the late 1980s at 50,000 pages per year (Steiner and Steiner 1991, 298). While generally viewed as burdensome by private industry, the impact of all of this regulatory activity is not necessarily negative. As Steiner and Steiner note "restraint for one person or business may mean freedom for another... regulations have protected and subsidized business interests as well as consumer and general-public interests" (Ibid, 299-300).

Regulation is a powerful tool but potentially an inflexible one with unforeseen consequences. It is interesting to note that the ICC by the midpoint of the twentieth century "had become the *protector* of the railroads" by regulating freight rate schedules in the emerging trucking industry (Heilbroner and Singer 1984, 209). This is a cautionary tale- the inflexibility of the regulatory or command/control approach can, over time, result in a disconnect from its original purpose as markets change and regulations do not.

2.2 The Federal Role Challenged

In recent years, the role of the Federal government has come under increasing scrutiny. The "Republican Revolution" of 1994 reinforced a general attitude particularly popularized during the Reagan Administration that "less government is the best government." As Newt Gingrich put it "The government is out of touch and out of control (Gingrich 1995, 424)." The Republican Revolution's manifesto, "Contract with America," indicted "the national government as 'too big, too intrusive, and too easy with the public's money' (Fisher 1995,20)." With the public debate focused on cutting $23 billion in public welfare spending, concern also surfaced in Congress over "corporate welfare" spending worth $85 billion, primarily through subsidies for everything from overseas product promotion to agricultural production (US Dept of Commerce, 1997) (Carney, et al. 1995, 36).
The regulatory functions of government, especially environmental regulations, have come under increasing attack as costly and unnecessarily intrusive burdens for businesses, both large and small (Benenson 1995,1693-96). Republican proposals in Congress in the Spring

of 1995 included cutbacks in corporate welfare as well as drastic reductions in Environmental Protection Agency funding and the elimination of the Departments of Commerce and Energy. Although most of these changes did not come to pass, many of the issues that surfaced during this period remain sources of sensitivity three years later. "Corporate welfare" has become one impetus for campaign finance reform and political pressure continues to support a shift away from regulations in favor of more participatory and voluntary programs.

Against this background, the idea that the federal government can have a positive impact on markets could easily be construed to have little popular support or credibility. Yet, the federal government is still in a unique position to introduce social values into the business equation. Steiner and Steiner describe the effective coordination between "free" markets and the public good as depending on self-interest, including a broadened acceptance of social responsibilities. They quote George Schultz as follows:

> Harnessing the 'base' motive of material self-interest to promote the common good is perhaps the most important social invention mankind has yet achieved... It seems strange that for a society that traditionally has boasted about the economic and social advantages of Adam Smith's invisible hand, ours has been strangely loath to employ the same techniques for collective intervention. Instead of creating incentives so that public goals become private interests, private interests are left unchanged and obedience to the public goals is commanded (Steiner and Steiner 1991, 325).

As previously stated, I feel that a key element of a successful market-based strategy is acknowledgment and acceptance that the participants will act in ways that are consistent with their economic and political self-interest. The case study presented in this paper will provide specific examples of how voluntary participation can be gained by recognizing and engaging the motivation of a variety of private interests to transform a market for the common good.

Market transformation can be defined in many ways. For the purposes of this paper, market transformation will be defined as a permanent change in the way that products or services are purchased, sold, or used. Arguments will be made to support the use of a collaborative approach and the value of engaging the supply side as well as the end use side of the market.

The Compressed Air Challenge will be used as an example of how the federal government can effect major changes through a collaborative intervention by: 1) carefully selecting a target market in which the government can have a reasonable chance of effecting change, 2) using a business approach in soliciting voluntary participation, 3) acting as a *catalyst* working with market forces rather than as a regulator trying to control them, and 4)enlisting suppliers as well as buyers of products and services.

2.3 Working With Market Structures

My argument that the most effective way for the federal government to voluntarily affect a market is to work within existing market structures is based on a series of assumptions. These assumptions are the result of: general reading on market structures; the experience and findings of the Motor Challenge program (described in the next section) and numerous conversations with participants in the supply and demand sides of the market. These assumptions include:

- no one entity has perfect information about a market or cluster of market structures; instead, market players are constantly seeking better quality information to gain a competitive edge. There is a cost associated with obtaining this information, which may or may not be correlated to the quality of the information;
- companies that are active on the supply side of a market remain in business because they make rational decisions in response to market pressures and customer needs. These decisions are based on knowledge of the market from the suppliers' point of view. This information can be quite detailed, highly valuable, and unavailable from other sources;
- companies that are active on the demand side of a market are seeking best value, which may not be immediately obvious and must be understood within the context of the buyer's priorities. The participation of "end user" companies is essential to the success of a market intervention;
- the federal government is typically viewed by private industry as an impartial source of consumer information. Voluntary association with the federal government is viewed with favor as long as the requirements for association do not excessively impinge on normal business functions. For the supply side of markets, the potential for brand enhancement and increased market access are important additional considerations;
- every market has independent experts- sources of both technical knowledge and market information who are viewed as respected sources by other market players;
- mature market structures are complex and evolve over time; the federal government cannot effectively implement policy through mechanisms that either ignore or attempt to duplicate these structures. However, the federal government can effectively represent the public interest by working within existing market structures to serve as a catalyst for shaping the direction and pace of market changes.

A key element of working within market structures is the effective engagement of the supply side of the market. Effective engagement of the supply side does not mean that all suppliers will approve of a collaborative intervention. What it does mean is that suppliers who self-select to participate will contribute the suppliers' point of view and help ensure the success of the intervention by becoming "early-adopters" in an effort to gain a competitive edge. Effective engagement recognizes both the durability of existing relationships between the supply and demand side as well as the potential for enlisting progressive suppliers as effective champions for change. Suppliers (manufacturers, distributors), with their technical and market knowledge and their ability to support (or resist) change in their interactions with customers, can enhance or severely hamper a market intervention effort.

2.4 Energy Efficiency and Market Transformation

Experience has shown that there are significant barriers to the introduction of an energy efficiency focus into markets for equipment purchase and use. For example, the US Department of Energy has characterized market barriers to greater energy efficiency in industrial electric motor systems as follows:

- lack of consistent, easy to use, and timely product information;
- lack of knowledge at the end user level regarding potential energy savings;
- lack of technical expertise and tools to quantify savings;
- failure to focus on life-cycle cost when making equipment purchases; and
- lack of incentive or motivation to demand high performance or promote efficient system purchases and design (US Department of Energy 1996, 5).

The energy efficiency of certain types of equipment has been permanently and substantially improved through regulation (residential appliances, heating and cooling equipment), through voluntary labeling programs (office equipment), and through utility-funded demand side management programs (fluorescent lamp ballasts, compact fluorescent lamps) (Harris and Casey-McCabe, 1997, 7) (Geller and Nadel 1994) (Energy Policy Act of 1992).

Examples of successful coordination between the public and private sector to promote energy efficiency (utility demand side management programs, voluntary standards), while frequently offering the participating private companies incentives for action, also carry some potentially negative consequence for failure to act (public utility commission action, perceived loss of market access, threat of regulation). There is precedent, however, for a totally voluntary public/private market intervention to promote energy efficiency. Two examples are the Energy Star program and the Motor Challenge program, although it could be reasonably argued that Energy Star carries a perceived threat of regulation through its association with the Environmental Protection Agency. Since the Compressed Air Challenge was an outgrowth of work on the Motor Challenge program, this example will be described in greater detail in the next section.

The key to the success of these voluntary efforts is flexibility and the ability to align the market interests of the various stakeholders to a sufficient degree that a common arena for action can be identified. The *challenge* is to translate the public goals into private interests so that a market can be transformed through the actions of the market stakeholders.

2.5 A Federal Voluntary Program : USDOE Motor Challenge

One program that seeks to employ a collaborative approach to market transformation is the USDOE Motor Challenge program. The Motor Challenge program is designed to promote greater energy efficiency in industrial motor-driven systems.

Approximately 70% of all electricity consumption by U.S. industries or about 550 billion kWh/yr is used to power electric motor-driven systems. Motor-driven equipment such as pumps, fan and blowers, and air compressor systems account for about 59% of industrial motor system consumption or approximately 325 billion kWh/yr (USDOE 1998, Section 1-26). The potential savings in system improvement opportunities are very large - over 50 billion kWh/year energy savings and $1.5 billion (US) annual energy cost savings with existing and new technology by 2010 (USDOE Motor Challenge 1997). System improvement opportunities may include: improved sizing and proper matching to load, use of more efficient drive trains, improved system layout, updated and well-maintained controls, improved operation and maintenance, and use of adjustable speed drives (ASDs).

Beginning in 1992, US DOE Office of Industrial Technologies (OIT) sought to design a program that promoted increased energy efficiency of motor systems and was responsive to industry needs. The Motor Challenge program began as the result of an industry roundtable discussion and evolved through a series of events that presented industrial end-users and the companies that serve them with a unique opportunity to share in and help shape the program. Participants in these events included representatives from: large users of industrial motor-driven systems; manufacturers and distributors of motors, drives, pumps, air compressors, fans and blowers, controls, and related equipment; industrial trade associations; utility companies; consulting engineers; and state and federal government. The result is a program "designed with industry for industry" that relies extensively on existing market forces to bring program messages to the industrial end-user (Scheihing,et al 1995).

Strategies

The most significant feature of the Motor Challenge Program is that its design is incremental and constantly evolving to more effectively meet industry needs. While the essential goals and purpose of the program have been established, the methods of achieving those goals (through program offerings and partnerships) are fluid and strongly allied with changing needs of industry. The program began in 1993-94 with three initial offerings: showcase demonstrations, MotorMaster software, and the Information Clearinghouse. As additional program offerings were developed and the ongoing dialogue with industry matured, a program structure emerged to deliver the program message within existing market mechanisms. Two structural elements will be considered here: Allied Partners (program delivery) and Industry Partners (product and services development). These two elements are related. It is anticipated that Industry Partners will also become involved in delivery of the products they help develop, thus creating an expanding network of program delivery.

The Motor Challenge Program's market-driven approach requires a delicate balance between the need to change existing behavior and the desire to work within existing, and potentially resistant, market structures. A clear recognition that all parties bring their own agenda to the table is an essential first step to identifying points of common interest and opportunity. The tension between the program message of energy efficiency and the commercial interests of companies delivering and developing this message must be recognized, discussed, and resolved. Working within the market can be rewarding and cost effective, but effective

program guidelines (e.g.- use of program name and logo) and oversight are essential to avoid seriously compromising the program message.

Program Delivery

Building partnerships enables the program to develop a very broad reach with a modest level of support from USDOE. Most program information is delivered to end use companies via Allied Partners, who are not paid to participate. These program participants include companies and organizations that routinely provide products and services to industry. Each Allied Partner must complete an Action Plan that outlines activities they agree to undertake, along with identifying the specific program offerings that they plan to distribute. They also agree to provide data concerning their use of program offerings, and on their experiences in working with customers using those materials. In exchange, most Motor Challenge program materials, publications, and software tools are available to Allied Partners in quantity and at minimal cost. There are sound business reasons why Allied Partners use these materials. For example, an Allied Partner may provide a "free" survey of a customer's motor systems and load the motor inventory into the MotorMaster + software. The result will assist the customer with motor system management and provide the Allied Partner with some extremely valuable marketing information.

Developing Product and Services

The current portfolio of materials, workshops, and software tools available through Motor Challenge focus primarily on energy-efficient motors and drives. To broaden the scope of program offerings to include motor-driven equipment such as air compressors, pumps, and fans and blowers, Motor Challenge forms *Industry Partnerships*. These partnerships can include: industrial trade associations, industrial end user associations, utilities and utility consortia, efficiency experts, and state government and are formed for the purpose of cooperatively developing new educational products, materials, and services.

Besides drawing on the technical strengths of trade associations representing original equipment manufacturers (OEMs) of motor-driven equipment and end user associations, these partnerships offer a significant cost-sharing opportunity for government (commonly referred to as "leveraging"). The main benefits to participants in Industry Partnerships are increased exposure, positive association with government, and the opportunity to meet new customer groups in a non-commercial setting. It was out of this work with Industry Partnerships that the Compressed Air Challenge emerged.

Effecting End User Change

The ultimate goal of the Motor Challenge program is a change in behavior of industrial companies that use electrical motor systems. Another key aspect of the program is to provide recognition for companies that are willing to try new approaches that increase efficiency. Showcase demonstration projects are case studies of these forward-looking

companies that provide recognition for them and examples to others. Feedback from industry has led the program to emphasize the connection between greater energy efficiency and increased efficiency of production, greater reliability, and reduced waste and pollution. Corporate leaders respond to these linkages because they have a good fit with issues of global competitiveness and fulfill corporate interests to be perceived as a “green”, or environmentally responsible company.

3.0 US Industry and Sustainable Development

The interest of US industrial users of motor systems in linkages between energy efficiency and efficiency of production, greater reliability, and reduced waste and pollution is all related to a larger global movement described as sustainable development. As described in Section 4.0, the production of electricity is a major source of environmental pollutants. US industry, in its drive toward overall efficiency of production, has begun to make important connections among reducing waste (including wasteful use of electricity), the public relations and other benefits of being identified with sustainable development, and profitability. The purpose of this section is to outline the major issues and governmental policy responses pertaining to sustainable development and climate change. The objective is to create a context for the participation of US industry in market-based programs such as Motor Challenge and the Compressed Air Challenge. Since these issues are extensive and complex, I will not attempt to be comprehensive, but rather limit the discussion to key and relevant points.

3.1 Sustainable Development and Climate Change

Sustainable development is a global approach to incorporating environmental considerations into economic development. This approach is needed because population increases and intensified use of resources as developing countries industrialize could outrun the ability of the planet to sustain a liveable environment within a few decades, absent technological innovations or other mitigating factors. The approach needs to be global, because many of the practices required to create sustainable development cannot be fully realized at the local or national level (Opschoor 1996,7 and Hart 1997,67- 68). According to Ehrlich & Ehrlich, as referenced by Paul Shrivastava in the Academy of Management Review, the world population will double from 5.5 billion to 11 billion by the year 2030. Production of goods will increase 5 to 35 times today's levels to meet both the population increase and a per capita increase in consumption, leading to an increase in environmental degradation unless new technologies, social organization, and production practices are found.

Sustainable development became an issue of global policy as the result of the July 1992 Earth Summit in Rio de Janeiro. However, the concept of sustainable development emerged in 1980 with the World Conservation Strategy from the Conservation of Nature:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs [WCED 1987,43] (Stern 1997,2).

Sustainable development is one strategy for reducing greenhouse gases that contribute to climate change. Climate change refers to the effects of:

> carbon dioxide and other gases, chiefly methane, that trap heat in the atmosphere much as glass panes trap it in a greenhouse. An international panel of scientists convened by the United Nations has predicted if current emission rates continue, the earth's average surface temperature will rise by 3 to 8 degrees Fahrenheit by the end

> of the next century. Many scientists believe that this would have a catastrophic effect on climate.
>
> Global warming and energy are inextricably linked because carbon dioxide, the most abundant and important greenhouse gas emitted by industrial society, is produced by burning fossil fuels like coal and oil. The United States... is the world's leading emitter of carbon dioxide. (Stevens, March 17 1992, 1).

Some European Union countries have provided governmental leadership in establishing CO_2 reduction targets. Spurred by high population densities and a reliance on industry and transportation for national growth, the Netherlands has been particularly aggressive in working with industry to help meet these targets (Porter and van der Linde 1995,1) (Opschoor 1996,7). The Netherlands enacted their first National Environmental Policy Plan (NEPP) in 1989; it includes timetables and targets for environmental improvement for eight themes ranging from climate change to groundwater depletion and "squandering" (of non-renewable resources). The core of the Dutch plan is a set of voluntary agreements between government and industry that carry significant rewards and penalties depending on whether targets are reached. The "Green Plan" has been so well publicized that "the national slogan -- 'A better environment begins with you' -- is now more widely recognized than the most popular brand of beer" (Steffen and Atkisson 1995,1-3). Although industrial growth has resulted in some difficulties in reaching all targets, the Netherlands continues to serve as a model of innovation for national environmental policy.

3.2 US Policy Response

In 1993, the Clinton Administration charged the President's Council on Sustainable Development (PCSD) with the task of preparing a broad-based report "designed to spearhead a national debate on how to achieve a new type of prosperity based on sustainable development (Olson 1996,1)." The PCSD report did not result in any cohesive US national policy for honoring the goals established at the last Earth Summit. While climate change and targets for CO_2 reduction are only one aspect of the much broader movement for sustainable development, they do provide a focal point for current global discussions on environmental impact.

The U.S. has been sharply criticized by its European allies for failing to implement a national policy that establishes CO_2 reduction targets. Both US industry and Congress have objected to CO_2 targets or committing to any policy that would impose costs on industries or limit the use of fossil fuels (Reuters, July 8 1996,4) (Cushman, June 24 1997, 9).

After a series of public challenges from the European Community, President Clinton made a speech to the UN in July concerning US commitments in preparation for the December 1997 Earth Summit in Kyoto. President Clinton announced several strategies to promote CO_2 reduction (tighter air pollution regulations, promoting solar energy) without establishing actual targets, which many U.S. companies continue to strongly oppose (Cushman, June 27

1997, 11). On October 22, President Clinton announced a long-awaited framework proposal to bring to the Kyoto discussions on climate change. This framework proposal includes three main elements: a global commitment to returning to 1990 emissions levels between 2008 and 2012, with further reductions in ensuing years; an international system of emissions credits and trading; and participation by both industrialized and developing countries in meeting the challenge of climate change (Office of Press Secretary 1997). As the result of the Kyoto summit, the US agreed to reduce emissions to 7% below 1990 levels, an international system of emissions credits and trading, and to defer discussion of participation by developing countries. Resistance to this agreement continues in both Congress and among many US industrial leaders.

3.3 The Corporate Response

While the US government struggles with establishing policy on climate change, many corporations, particularly multinational corporations, are developing new approaches for improving environmental conditions, including CO_2 reduction, an essential element of climate change mitigation. This may seem to be an argument in support of a position that government involvement is not needed to achieve sustainable development; however, I think that it actually illustrates that participation by corporations can occur voluntarily if public good can be effectively linked to private profit potential. The companies currently involved in sustainable development are corporate leaders; they are not the majority of participants in the private sector for whom the linkages to profit potential (or the down side of inaction) must be made much more explicit. National governments must work with the private sector because corporations are absolutely essential to achieving any lasting improvements:

> The roots of the problem -- explosive population growth and rapid economic development in the emerging economies -- are political and social issues that exceed the mandate and the capabilities of any corporation. At the same time, corporations are the only organizations with the resources, the technology, the global reach, and, ultimately, the motivation to achieve sustainability (Hart 1997, 67).

The Elements of Sustainable Development

Sustainable development as described here focuses on those elements that concern the manufacturing sector. It can include a range of activities by corporations that are designed to minimize waste and reduce resource inputs required for production. Sustainable development can be described in terms of three stages. Stage One is pollution prevention, which seeks to minimize or eliminate waste, as distinguished from pollution control, which is oriented toward cleaning up waste after it has been created. As Stuart Hart notes, "this transformation is driven by a compelling logic: pollution prevention pays (Ibid, 70)." Stage Two is product stewardship, which focuses on all of the environmental impacts associated with the full life cycle cost of the product, not just from manufacturing. For example, a company concerned with product stewardship will extend efforts for waste reduction from its own manufacturing facilities all the way back through its supply chain and all the way forward to a "least impact" disposal of a product once it has fulfilled its useful life. Product stewardship as "one

way to reduce consumption in the developed countries" that "offers the potential for revenue growth through product differentiation" as companies advertise the "green" aspects of their products (Ibid, 73-74). Hart further notes that product stewardship has the potential to dramatically reduce the amount of material required for manufacture, resulting in higher profit margins. Stage Three of sustainable development is clean technology. Clean technology implies a major technological shift to greater environmental sustainability- a totally new way of doing things that eliminates the negative environmental impacts of the products or processes that it replaces.

The Responsible Care movement in the chemical industry is an example of pollution prevention and the movement toward product stewardship. Kent Gilgas writing in Chemical Engineering describes the motivation for Responsible Care as follows:

> In the seventies and eighties, environmental degradation caused by the CPI [*author's note: chemical processing industries*] could no longer be ignored. The Baltic Sea and Lake Erie were close to being biologically dead. The Rhine River caught fire. The Elbe River was a toxic soup. The U.S. government warned not to eat fish from the Great Lakes because of mercury and PCB contamination. And more than 2,000 people died as a result of the chemical catastrophe in Bhopal, India.
>
> The chemical industry, facing massive public distrust, made a monumental decision to 'go public.' Chemical manufacturers began to open their environmental books and invite the public into their decision making processes. The result was a voluntary, ethical framework, called Responsible Care, within which member and partner companies of the Chemical Manufacturer's Assn. (CMA) and the European Chemical Industry Council (Cefic; Brussels) now operate.

Although the program has produced some real results (for instance, Dow Chemical's early efforts reduced annual emissions of one type of toxic emission by 51,242 tons), the program participants are now facing even greater challenges as they move through Stage Two (product stewardship) and Stage Three (clean technology) of sustainability.

While the chemical industry has been at the forefront of U.S. innovation on sustainable development, many other U.S. corporations have begun introducing elements of sustainable development, primarily through the inclusion of total quality environmental management (TQEM) in a larger move toward advanced manufacturing systems. These systems include a number of innovations that affect not only production but organizational structures and supplier relationships. For example, as part of its efforts to reduce cost and waste, Sony's Westmoreland, PA, television plant worked with its suppliers to completely recycle all of the scraps and other products of the production process. These efforts included, among many others, redesigning packaging and changing to a water-based paint (Florida 1996, 9).

Companies do not undertake these kinds of sweeping changes without careful consideration. ISO 14001 is an international voluntary standard for environmental management systems, as

John S. Willson and Ronald A.N. McLean explain in a journal article for the paint industry "ISO 14001: Is it for you?". However, they also note:

> much of the current debate regarding the desirability of gaining certification to the ISO 14001 standard comes down to a perceived lack of a clear, compelling 'business case' for doing so. For many companies, at least in the United States and Canada, this case simply has not been made, especially where there is no significant pressure from external stakeholders. In these two countries, the current situation regarding ISO 14001 is a strange mix of industry interest and awareness with a real reluctance to commit to something that may not offer business value or advantage. In Europe and much of the rest of the world, some of these same business reservations may exist, but are more tempered by political and societal norms and expectations (Willson 1996, 2).

With regard to advanced manufacturing, Richard Florida states that the:

> data on pollution control and abatement expenditures by U.S. manufacturers compiled by the U.S. government indicate a shift in the share of expenditures from control technology to production process improvements. ... There is considerable literature documenting the shift to new and innovative manufacturing systems among firms, referred to variously as lean production, agile manufacturing, and high performance production. These advanced manufacturing systems are distinguished by a blend of technological and organizational changes inside the factory (e.g., self-directed work teams, worker rotation, and continuous process improvement) and by close and interdependent relationships across the production chain, particularly between end-users and suppliers (Florida 1996,2).

U.S. companies that have progressed the furthest in implementing advanced manufacturing systems tend to be large- over $500 million in sales (Ibid, 9). They also tend to invest substantially greater resources in research and development as they seek new approaches to resolve environmental and production problems. Florida concluded from survey results that so-called "green-design" plants tend to be "larger, to be more R&D intensive, to introduce greater numbers of products and product designs, and to involve workers in continuous improvement. There was a strong relationship between R&D intensity and green design, suggesting that environmental innovation is associated with innovative effort and activity more generally (Ibid, 11)."

3.4 US Industry and the Compressed Air Challenge

In looking at the possible linkages between the industry participation in the development phase of the Compressed Air Challenge and industry participation in sustainable development, several threads emerge. First, the type of companies that have expressed interest in the Challenge tend to be large corporations with a heavy dependency on compressed air systems and a history of an internal commitment to at least some of the elements of sustainable development. These elements include: pollution prevention, product stewardship, total quality environmental management, and advanced manufacturing

techniques. Some of these companies (e.g.- Dupont, 3M, Ford) are globally recognized for these efforts. Others (Potlach, Georgia-Pacific, Inland Container, Weyerhauser) come from an industrial sector (pulp and paper) that has focused on environmental improvement and energy cost reductions for more than two decades due to pressure from environmental regulations and global competitiveness.

Second, these companies are interested in the positive impact on profitability through waste reduction, greater reliability, and tighter quality control likely to be realized through use of the information developed by the Challenge. They are interested in investing time participating in development of Challenge materials in order to obtain this information before their competitors do.

Finally, they are interested in the linkage between the Challenge and satisfying possible future CO_2 reduction targets. The Challenge is a tangible voluntary activity that they can participate in now, thus showing, at a very low risk, their intent to mitigate climate change. The projected annual energy savings from the Challenge is 10% of all industrial compressed air system energy, a relatively modest estimate when compressed air system efficiency improvements per plant typically range from 20-50%. This translates into approximately 3 billion kWh/yr, or 500,000 tons of CO_2, 12,000 tons of SO_x, 7000 tons of NO_x, and 250 tons of particulate matter[1].

[1] These figures could be substantially higher based on projections in the USDOE Draft Final report *United States Industrial Electric Motor System Market Assessment*, June 1998.

Overall, efforts to engage US industry as participants in the development phase of the Compressed Air Challenge have been reasonably successful. It is extremely difficult to get commitments of time from already overtaxed plant operations personnel and energy managers for activities that aren't directly related to an immediate problem. Despite this, representatives from two dozen corporations[2] have agreed to assist in reviewing and shaping the three major first-year products of the Challenge. Designed to promote compressed air system best practices, these include: a customer awareness campaign (including two messages- for management and for plant operations personnel), a training curriculum for plant operations personnel, and a framework for certifying plant operations personnel. The participation of plant operations personnel is critically important to ensure that the Challenge products are useful and effective in reaching the target audience. As the results of the Challenge become more evident, it is anticipated that many more companies that are end users of industrial compressed air will become involved in the implementation phase in the second year.

In addition to the sustainable development linkages mentioned previously, success in recruiting corporate involvement can be attributed to a number of factors:

- Only one end-use participant, the representative who volunteered for the Project Development Committee (see Section 6.0), is expected to attend meetings away from the work site. The remainder of industry participants will be encouraged to communicate via email, fax, and telephone conferencing from their work location.
- Compressed air end use industries were not approached for monetary sponsorship of the project. This was based on an early decision to focus end-use recruiting efforts on their critical participation in both development and implementation of the Challenge.
- Recruitment is being built on existing networks: referrals from compressed air system consultants and equipment suppliers; corporations that have already shown a high degree of commitment to the Motor Challenge; presentations at end-use professional association meetings; and self-referrals from web site and newsletter postings.
- The Challenge is attempting to solve a real problem in many plants- extremely poor compressed air system efficiencies and operational effectiveness. These problems are stated clearly in the Challenge prospectus and presentation materials. The planned products are attractive because they emphasize value and will be available in the short-term.
- The inclusion of private-sector participants (consultants, manufacturers) already associated with the Challenge clearly distinguish it from "just another government program."

[2] Includes: 3M, American National Can, Ash Grove Cement, Bethlehem Steel, Boeing, Champion International, Chrysler, CMS/MST, DuPont, Ford, General Mills, Georgia-Pacific, Inland Container, John Deere, Kelsey-Hayes, Libbey, Potlach, Pratt&Whitney, Quad Graphics, Roche Vitamins, S&C Electric, Steelcase, Texas Instruments, Weyerhauser

- End user companies that are involved in the Challenge receive substantial national press for their efforts, that began with a Washington-based press event held in January 1998.

4.0 The Role of Utilities in an Era of Change

No discussion of the compressed air market would be complete without a discussion of electric utilities. The current restructuring of electric utilities is likely to have a significant impact on way that compressed air equipment and services are packaged, sold, and used. Restructuring has also had a major impact on utility participation in the Compressed Air Challenge. Since utility market transformation efforts and restructuring are very broad topics, this section makes no effort to be comprehensive, but rather focuses on providing a brief context for the compressed air market discussion that follows.

Since the Federal Power and Public Utilities Holding Company Acts in 1935 (which also coincided with widespread electrification of the US), utility companies have provided electricity to industrial, commercial, and residential customers as tightly regulated de jure franchise monopolies. Approximately 250 investor-owned utilities were in existence as of 1996 (White 1996 1). The electricity market is extremely important- electric utility retail sales in 1995 were approximately $208 billion, or 3 percent of gross domestic product, far more than any other industrial sector considered for deregulation (Ibid 2). It also has unparalleled strategic importance- without electricity, our entire social, defensive, and economic structures would cease to function.

The environmental impact of electricity production is also significant. The Environmental Protection Agency (EPA) reports that in 1993 power plants were responsible for 72 percent of all sulfur dioxide emissions, 33 percent of all nitrogen oxide emissions, 23 percent of all mercury emissions, and directly contributed to 36 percent of carbon dioxide emissions in the U.S (EPA 1995). Thus, energy efficiency is a major factor in achieving goals for reducing pollution as well as greenhouse gases (predominantly CO_2) that contribute to global warming.

The purpose of this section is to describe the major factors affecting utilities' support or lack of support for in the Compressed Air Challenge. Issues discussed will include: demand side management, utility restructuring, the emergence of energy service companies, and market transformation.

4.1 Utilities and Demand Side Management

Beginning in the late 1980s and continuing through the mid-1990s, electric (and, to a lesser extent, natural gas) utility companies in the U.S. expended approximately $15 billion dollars on programs and incentives designed to reduce energy consumption (Elliott and Pye 1997). At its peak in 1994, $335 million were spent on these activities in California alone (Messenger 1996, 52). The utilities entered into these programs and incentives, known collectively as demand side management (DSM), at the direction of state level Public Utility Commissions (PUCs). The PUCs typically directed the utilities to engage in demand side management as a cost effective and non-polluting alternative to the construction of new power plants required to meet increased load demands. DSM also became a strategy to

avoid bringing controversial nuclear plants on line or to permit their early retirement from service.

Funds for DSM were drawn from the ratepayer base. In selected states in later years, DSM programs also included PUC allowances for participating utilities to take financial writeoffs for expenditure of DSM funds.

The results are summarized by Joe Eto, et al. in The Electricity Journal as follows:

> ...years of ratepayer-funded support for utility demand-side management (DSM) programs have created a substantial utility DSM delivery infrastructure. The range and scale of programs offered by U.S. utilities provide unprecedented examples of conscious market interventions to achieve various public policy objectives. In Western Europe, governments have relied primarily on building codes and tax policies, which increase the price of energy, as the most formal public policy instrument for energy efficiency. Until quite recently, most utilities outside of the U.S. (except perhaps, those in Canada) have had little or no formal experience with DSM programs (Eto, et al 1996, 1).

DSM programs included a variety of offerings such as: informational and educational materials; energy audits or technical assessment services; training seminars and workshops; project financing, and product rebates. Of the billions of dollars spent on these programs, the highest expenditures by far were on product rebates paid to customers. While these programs were criticized by some as ineffective (Meyers, et al 1997, 2), they were responsible for some significant successes, including, as previously mentioned, a permanent change in the market for electronic ballasts and compact fluorescent lamps. As Ralph Cavanaugh notes, "By 1994, the average cost of saved kilowatt-hours to California utilities had dropped below two cents per kilowatt-hour, and Southern California Edison was announcing an energy efficiency portfolio that would be cost-effective even if credited solely with the value of the unburned fuel (quoted from The Future of DSM in a Restructured Electricity Industry; E. Hirst, R. Cavanaugh, and P. Miller)."

By the mid- 1990s, after several years of operating DSM programs, both utilities and the PUCs that regulate them had started to transition from cash-intensive customer rebates and short-term DSM strategies to a more comprehensive market transformation approach. This transition was both a reaction to impending utility restructuring and lessons learned from operating DSM programs. In this context, market transformation can be defined as follows:

> Market transformation programs are specifically designed to bring about lasting changes in energy-related decision making, by reducing or eliminating market barriers to efficient practices so that various market actors have a self-interest in making efficient decisions. ...The reduction in market barriers is evidenced by a set of market effects that last after the intervention has been withdrawn or reduced (Eto, et al. 1996 11)

To be effective, market transformation activities need to involve many different market stakeholders, address the complexities of existing markets, and occur in more than a single utility territory. As electric utilities prepare for and enter into restructuring over the next several years, they and their respective PUCs are involved with a complete renegotiation of their obligations for DSM. This creates an opportunity to develop more complex energy efficiency approaches that may be more effective and long-lasting than those produced by DSM.

4.2 Electric Utility Restructuring

In recent years, there has been considerable interest in restructuring the relationship between electric utilities and their customers to allow increased wholesale and retail competition. Restructuring involves regulatory actions to "unbundle" electricity generation and sales from its delivery (regional transmission and local distribution) (White 1996 1). In addition to the effects of regulated unbundling, other market segments likely to emerge include : energy services, power markets, and information technology products and services (Weiner, et al. 1997 21). Utility restructuring has already occurred in a number of countries, including Great Britain and Argentina. Coincident with these regulatory changes are technological changes that permit cost-effective production of electrical power or combined heat and power at a smaller scale, thus encouraging site-based capacity for industrial customers.

In 1992, Congress passed the National Energy Policy Act, which allowed a wholesale customer to purchase power from the lowest cost producer and require the surrounding utilities to "wheel" this power over their transmission lines in exchange for a fee (Moyer 1996 2). In April 1996, the Federal Energy Regulatory Commission (FERC) issued regulations that formally established the framework for federally regulated transmission and state regulated distribution in a restructured environment.

While the states' regulatory actions in response to the FERC decision will take place over the next several years, electric utilities have already begun to change their relationship with customers. This is particularly true of industrial customers:

> Much of the utility industry flux has been driven by large customers seeking service at a lower cost and threatening to relocate, self-generate, or turn to alternative electricity service providers. Large industrial customers represent a substantial customer base for most utilities, and the loss of these customers could have devastating financial consequences (Elliot and Pye 1997 7).

As John W. Rowe, former president and chief executive officer of New England Electric Systems (NEES) said in response to the impending changes in the utility industry "you have two choices...You can say bad things are going to happen and I'm just going to grind them out and delay them as long as I can. Or you can say bad things are going to happen, but maybe they'll hurt me a lot less if I get out in front and try to shape them" (as quoted by Margaret Kriz). Rowe was actively engaged in developing a utility-restructuring agreement for Rhode Island that is becoming a template for similar restructuring actions throughout

New England (Kriz 1996 4). It is not surprising that NEES was the first utility to agree to sponsor the Compressed Air Challenge.

4.3 Energy Service Companies

An important element of utility services to industrial customers emerging from restructuring is the energy services company or ESCO. While ESCOs have existed independently for many years, the entry of well-capitalized utilities into this market is likely to result in substantial changes. Weiner, et al., describe the role of ESCOs as follows:

> ESCOs will specialize in bundling power with related energy-management and consulting services for very large customers- in effect moving further up their customers' energy "value chains." ESCOs not only will procure cheap energy (not just electric power) but will work with their customers to tailor strategies and process improvements to reduce their energy costs (Weiner, et al. 1997 29).

Truly effective "out-sourced" or "over-the-fence" energy services will probably be bundled by ESCOs with other facilities operations and possibly telecommunications services to provide key customers with a full- service approach. Already utility ESCOs such as DukeSolutions and Evantage are experimenting with bundling technical consulting services and steam, compressed air, electricity, and chilled water for large industrial and commercial customers (Thielemann 1997, Elliott and Pye 1997 13). Since these utility ESCOs are emerging from a rate-payer funded regulated environment, the potential for conflicts of interest between regulated and non-regulated segments will need to be closely monitored. As J. Eto, et al. note: "utilities will attempt unfairly to use competitive advantages that derive from monopoly to enhance their position on the unregulated side of the business."

4.4 Market Transformation in a Restructured Utility Environment

The states who are furthest along in the restructuring process (California, Massachusetts, New York, Rhode Island) are taking steps to preserve a source of funds for energy efficiency programs and services and assistance for low income households. This "systems benefit charge" typically requires no change in rates, rate structures, or cost allocations among customer classes because utilities recover the equivalent of these charges under the current electricity delivery structure (Cavanaugh 1996 5). Since many utilities already have the program delivery infrastructure, it is likely that utilities will continue to promote market transformation through programs funded by the public benefits charge. Two regional market transformation efforts are already underway in the Pacific Northwest and New England, funded through a mix of holdover funds from DSM and new "public benefits" funds..

Barriers to effective implementation of utility market transformation programs under the public benefits scenario include:

- reallocation of the most talented managers and planners to the corporate priority-restructuring;

- the apparent conflict between energy efficiency initiatives for market transformation adopted at the system-wide level and anticipated cutthroat competition in power marketing;
- and a determination on the part of utility management to avoid any potentially "strandable costs" in addition to the substantial amount already at risk during the restructuring period (Ibid 4).

4.5 Utilities and the Compressed Air Challenge

Restructuring has created a significant barrier for soliciting utility interest in the Compressed Air Challenge, primarily due to the resulting diversion of effort and high degree of uncertainty. Based on my previous experience in marketing DSM support services to utilities, this situation would not have been the case as recently as two to three years ago. At that time, a program which offered a 10 to 1 funding match, required a modest $30,000 investment, had concrete deliverables suitable for local distribution, and provided access to the collective wisdom of the top compressed air experts in the country would have been a very easy sell. During the summer months of 1997, when sponsors were being sought for the Compressed Air Challenge, I was repeatedly told that although it was a "great project", no commitment could be made. Reasons most commonly given included: the utility company was just purchased or merged with another, resulting in a total freeze on new commitments; the utility wasn't sure that getting involved in a national effort of public benefit was in their best interest; or the entire company's energy efficiency effort was being re-evaluated and might not be continued. Of the utility or utility consortia who have already agreed to sponsor the Compressed Air Challenge, most are using funds dedicated to market transformation or the "public benefit" side of the utility business. These include: NEES; Eastern Utilities, the Consortium for Energy Efficiency, a national utility collaborative; and the regional utility-funded market transformation effort in the Pacific Northwest, the Northwest Energy Efficiency Alliance. Recently, several other utilities have expressed interest in sponsoring the Challenge. The reason given for the recent upsurge in interest has to do with timing- as of the first quarter of 1998, many utilities have budgets for market transformation in place after a period of reorganization and uncertainty.

It is not surprising that utility ESCOs emerging from the unregulated side of the utility business have limited interest in investing in a collaborative national effort. Since ESCOs are trying to position themselves in the market by providing unique bundles of services to industrial customers, including compressed air, participation in a collaborative activity like the Challenge could be perceived to be inconsistent with developing a unique market identity. However, one prominent ESCO has recently joined the Challenge as a sponsor as a way of gaining a competitive edge. It will be interesting to observe the level of participation by ESCO staff in the training and certification programs to be offered by the Challenge. I would expect that it will be quite high, as many new utility ESCOs must quickly acquire either the internal capacity and/or contractual relationships with compressed air system experts necessary to honor their service commitments to industrial customers.

5.0 Industrial Compressed Air System Improvement Opportunities and the Industrial Compressed Air Systems Market

The reasons why the federal government selected the compressed air industry for a collaborative intervention can best be explained as a combination of *opportunity and possibility*. The *opportunity* is in the energy savings coupled with corresponding improvements in quality control and reliability of production. In the parlance of energy efficiency, industrial compressed air systems represent a rare example of an untapped "cherry-picking" opportunity- that is, a large potential for energy savings from a relatively small effort. When one considers that a 1-2% improvement in motor efficiency would be considered significant, the 20-50% improvement potential in many industrial compressed air systems using existing technology is truly impressive. The fact that these improvements frequently result in measurable productivity improvements and reductions in polluting waste creates an "everybody wins" appeal.

The *possibility* comes from these market characteristics: the way that the compressed air systems market is currently structured, and the internal and external pressures for change. One reason why it is so difficult to use a collaborative approach to transforming a market has to do with the sheer size and complexity of existing market structures. Although the industrial compressed air systems market is complex, the supply side of the market is highly specialized and relatively compact, with a limited number of players. It is possible to seat representatives from all major equipment manufacturers around an average size conference table. Although there are thousands of equipment distributors, 600 of the most influential distributors are represented by a handful of associations. Highly skilled compressed air system consultants are so few in number that they can participate in a conference call. This allows for negotiation, consensus-building, and the rapid exchange of information to effect change.

Another characteristic of the supply side of the compressed air system market is that it is a mature market under both external and internal pressure to change. Internal pressures include low margins of profitability and the drive for greater economy of production. Externally, the market is being pressured from several sources: globalization, utilities entering the business of providing industrial customers with compressed air, the increased use of improved electric tools instead of air tools, and customer dissatisfaction with existing services and equipment performance (see Section 5.2 for greater detail).

A large energy efficiency opportunity, a compact market, and internal and external forces for change are all factors that make the industrial compressed air system market a particularly appealing place for the federal government to attempt a collaborative intervention.

5.1 Energy Savings and Environmental Opportunity

Optimization of compressed air systems represents one of the largest non-process, industrial energy efficiency opportunities, with improvements of 20-50% readily achievable through the introduction of a best practices approach. Lack of information has been a primary barrier to realizing substantial improvements in the efficiency, reliability, and productivity of industrial compressed air systems. Compressed air systems in U.S. manufacturing account for $1.5 billion per year of energy costs and 7 MMTCE of total U.S. carbon emissions (½ percent of total U.S. emissions). The Compressed Air Challenge seeks to save $150 million in annual energy costs by the year 2010 (USDOE, 1998 Compressed Air Challenge Kickoff)[3].

Compressed air systems used in plant manufacturing consume 27-32 billion kWh/yr of electricity (Ibid. 1996 Vol.II 64). Compressed air is industry's "fourth utility"; it is central to production for many industries, including: chemicals, textiles, general manufacturing, plastics, mining, glass, pulp and paper, shipbuilding, furniture, automobile and aircraft manufacturing, iron and steel-making, and petroleum refining. Compressed air is used extensively as a source of power for tools and equipment as well as in industrial processes for pressurizing, atomizing, agitating, and mixing applications.

Compressed air is the most expensive utility; a single compressor delivering 500 standard cubic feet per minute (scfm) 24-hrs per day can cost $100,000 year to operate (See Figure 1). If the company using the compressor has a 5% net profit ratio, the cost of operating the compressor will be the equivalent of $2,000,000 in production (Foss 1994, 71). In spite of its cost, this level of waste in a manufacturing facility is not uncommon, due to poor system operation coupled with a perception by production staff that compressed air is "free". This is largely because compressed air is already present in distribution piping in the plant and the user is neither knowledgeable of nor responsible for the electricity bill associated with its use.

Compressed air systems are modified over time and frequently suffer from some or all of the following:

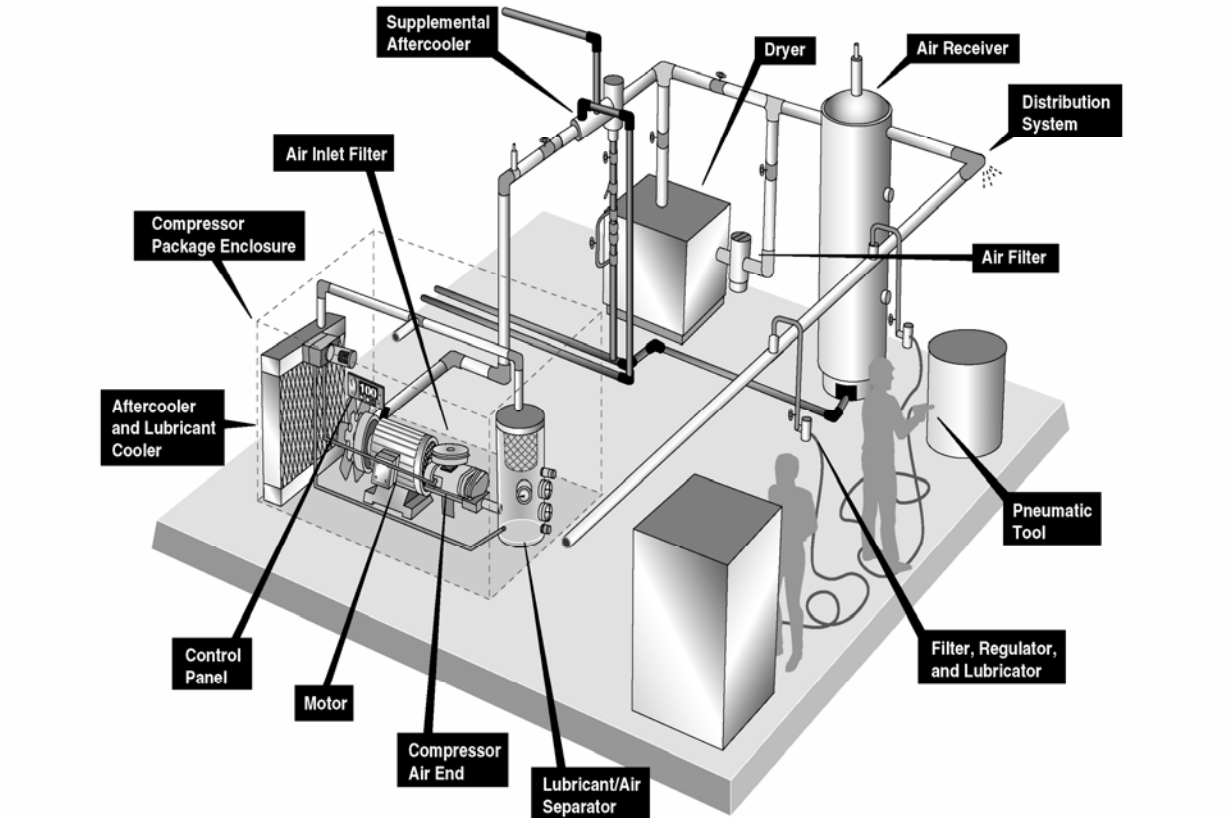
- improperly installed and/or leaking distribution lines;
- outdated or inadequate controls;
- poor maintenance of filters and other accessories;
- mismatch of compressors to load;

[3] Both usage and potential savings figures could be substantially higher based on projections in the USDOE Draft Final report *United States Industrial Electric Motor System Market Assessment*, June 1998.

- excess compressor capacity;
- higher than necessary system pressure, and
- inappropriate applications.

Figure 1

Compressed Air System Diagram



Although the cost of operating compressed air systems is high, it is a small fraction of the overall cost of production and receives little attention, as long as the air supply is adequate. Compressed air systems are not well understood by the majority of plant operations staff; modifying a system, no matter how poorly it is operating, is perceived as a risk to production[4].

A compressed air system consultant provides the following description of the industrial customer's decisionmaking process:

> Production said that they needed 90 psig, but it would be nice if they could have more than that... I asked how much more. They said 100 psig. Again, why? They said more would be "nice." It would have required 2300 hp to elevate the pressure 15 psig above the current lowest pressure of 85 psig. That would cost $1.3 million. I asked what they would get for the elevated pressure. The spokesman said, "I don't know... probably feel a little better about the reliability of the air system, but I didn't consider how much it would cost." (Foss 1993, 43)

5.2 The Industrial Compressed Air System Market

Like many industrial markets, little is written about how the market for industrial compressed air systems actually operates. Much of the information in this section has been taken from two primary sources: a conference paper by a marketing manager from a major compressor manufacturer and numerous informal "hallway" and telephone conversations with distributors, consultants, end users, and others. Except where specifically authorized, the sources for this information will remain confidential.

Wayne Perry of Quincy Compressor delivered a paper at the 1998 Industrial Energy Technology Conference entitled " The State of the Industrial Compressor Market" in which he described the existing compressed air equipment market and the relationship between equipment buyers and sellers. The major points made in this paper have been subsequently reaffirmed through several other sources and will be referenced several times in this section.

Perry describes the industrial compressor industry as a mature market with the following characteristics:

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[4]The information in the preceding two paragraphs is the result of numerous conversations between the author and manufacturers, distributors, consultants, energy experts, and end users of compressed air systems over a period from 4/95-10/97. This material was used in the prospectus and presentation materials developed by the author and others for the Compressed Air Challenge (see Section 6).

> No truly new compressor technology has been introduced in the past thirty years and there is none on the horizon. Competitive pressures have pushed manufacturers to increase per-employee productivity and implement strict inventory and purchasing procedures to maintain profitability. Many major players that were in the rotary screw industry *[author's note- the rotary screw compressor is the most common type sold to industry]* ten to fifteen years ago (Joy, Chicago Pneumatic, Worthington and Kellogg, to name a few) are gone.
> ...When inflation... is factored in, industrial compressor prices have held steady or fallen in each of the past five years. With these market conditions, it is likely that the number of companies that manufacture industrial compressors will continue to decline. The companies that survive and grow will be the ones that offer solutions instead of just equipment (Perry 1998, 71).

Numerous end-users, consultants, and distributors have confirmed that this is a market in which equipment distributors are the primary source of information for small to medium size companies. Distributors operate in an intensively competitive market in which customers typically buy substantial pieces of equipment (purchase prices can range from $50,000 to a million or more for a major new system) on a lowest first cost basis, margins for equipment sales are extremely tight, and long-term equipment service contracts are essential to economic survival. The focus on lowest first cost persists despite the fact that many large compressors cost more to operate in the first year than initial purchase price (Kemp 1998). Most companies administer separate budgets for capital projects and operating expenses, so economy in one area may have no value for the other.

Perry identifies "three common themes" that equipment sellers present to buyers:

1. The seller's equipment and service are the best available in the market.
2. The seller's equipment is adaptable to the user's needs, regardless of the application specifics.
3. All of the user's problems can be solved by adding more of the seller's equipment, without having to thoroughly define the problem in the user's system.

He cites a lack of complete information from manufacturers on equipment performance as adding to user confusion when trying to make purchasing decisions. This is further complicated by the fact that a compressed air system is dynamic and "most manufacturers cannot be of much help when predicting the behavior of their products in dynamic systems" - mainly due to lack of available training and experience (Perry 1998, 72). One equipment distributor described the situation as "providing pre-packaged solutions to an undefined problem on a lowest first-cost basis" (McMorrow 1998).

The Compressed Air and Gas Institute, the trade association for the compressed air equipment manufacturers, has made a commitment as part of their work with Motor Challenge to begin publishing information on component performance that is measured and reported in a standardized format. This is a very good start, but the issue of how the equipment will perform in a dynamic system in a plant setting is far more complex.

On the buyer's side of the equation, things aren't any better. Purchasing decisions may be made entirely with in-house advice plus distributor input. If it is a large company or a large purchase is anticipated, an outside consultant may used to evaluate the system. Compressed air system consultants are highly specialized experts who focus on understanding these system dynamics to better assist their industrial customers. Consultants look at, measure, and evaluate the entire system operation, including: demand and supply management, waste reduction, evaluating the need for unregulated uses, maintenance practices, operating conditions, and control strategies. Often, significant savings can be obtained from relatively low-cost changes in the way that compressed air is used, stored, or supplied (Howe and Scales 1995) (Van Ormer 1997)(Foss 1997).

Consultants' knowledge is experiential (or as one noted- learning by failing) and has taken years to accumulate; the demand for their services is high. Since other independent sources of information are extremely limited and academic training in compressed air system performance is virtually non-existent, consultants who do not already have extensive experience learn on the job. Unfortunately "there is no professional organization to certify these consultants and anyone who can spell CFM can claim to be an expert" (Perry 1998, 74). An engineering consulting firm that is highly skilled in other systems work and familiar to the end user company may or may not have sufficient practical experience to properly identify compressed air system improvement opportunities. The engineering firm may seek advice from the same equipment distributors as their client does, thus retracing the information circle (Foss 1998).

Since capital budgets and operating budgets are separate, there is little incentive to spend any extra capital on either efficient equipment or a comprehensive system approach to reduce operating expense. End user companies frequently will not pay for quality services because they do not understand what they need. The end user decisionmaking process can be described as follows:

> Compressor salespeople have learned that if the person to whom they are speaking understands the technical details that set compressor designs apart, the salesperson is probably not talking to the person making the purchasing decision (Perry 1998, 73).
>
> The plant engineer will make a purchasing decision based on one or both of the following criteria:
>
> 1. Which presentation and presenter best represented his or her companies' claims?
> 2. Which company had the lowest price?
>
> This method of determining solutions may result in a $50,000.00 solution to a $500.00 problem (Ibid, 71).

Perry describes a classic buyer/seller interchange concerning a low pressure dilemma in a plant after installation of a new end use. We join the plant engineer after he/she has requested and received internal approval to take bids for more equipment. He feels the

equipment is needed because his current equipment is in good working order per his supplier but he can't meet the pressure requirements of new production equipment. Although all of the information at his disposal supports the equipment purchase solution-

> A simple solution to the problem would be to move the compressor *[pressure]* sensor to a position downstream of the dryer and adjust the pressure setting to account for the pressure drop through the dryer.
>
> If the plant engineer buys and installs a larger compressor, a larger dryer and enlarges the distribution system, the low pressure problem will go away and the presenter *[bidding salesperson]* will make a commission that will allow him to buy new shoes for his children. If the plant engineer moves the pressure sensor on his current compressor, the presenter risks alienating the engineer by telling him that he is wrong, makes no commission and gets fired for being an under-producer. What does the presenter do in this case? He probably tells his service department to move the compressor's pressure sensor to the downstream side of the dryer... when the new equipment is installed...just to be safe (Ibid, 73).

This illustration, while amusing, describes a common situation that contributes to oversized systems. Once mistakes involving unnecessary capital expense are made, too much is at stake for an end user to readily correct the situation. How do you explain to your boss that you spent $80-100,000 or more last year on a remedy that wasn't needed or effective? The answer is that you don't- and unless you have really painted yourself into a corner through repeated mistakes that have rendered your system inadequate to meet production needs, you may be inclined to "shoot the messenger" who brings these errors to your attention. The result is systems that are not understood, continue to operate poorly, waste energy, and cut into profitability. Many times, it is only when a new facilities person takes over or management begins to question overall costs that cycles like this can be broken.

As Perry and others have pointed out, this is a well-known fact in the equipment industry:

> *[Compressor]* Manufacturers know that most plants are not generating compressed air economically. They know that most compressed air systems are really just a collection of components, assembled without a good understanding of how well they will work together. ...Most compressor manufacturers design controls that will protect the compressor, knowing that the compressor will likely be unintentionally misapplied. The controls are not usually designed to maximize the efficient conversion of electrical energy to pneumatic energy because that would raise the price. This knowledge brings the manufacturer back to the two main criteria upon which most compressor purchases will be made:
>
> 1. Which presentation and presenter best represented his or her companies' claims?
> 2. Which company had the lowest price?
>
> Most manufacturers, therefore, see that the highest return on investment is achieved when they:

1. Design compressors that can operate smoothly in a poorly engineered compressed air system.
2. Design compressors that have a low initial purchase price.
3. Provide an abundance of sales, marketing, and presentation materials for their distributors (Ibid 73).

This is a chicken or egg dilemma. Until end users ask for a different approach, manufacturers and distributors cannot afford to concentrate on one or they will go out of business before they have a market. Lacking information, end users do not know what they need nor how to manage any perceived increase in risk from taking a non-traditional approach. There are already small movements in the market, created primarily by skilled consultants, cutting-edge distributors, and to a lesser extent, entry of emerging utility ESCOs (DukeSolutions, Evantage, CINergy, Enron, Southern Company Services) and "deep pocket" players like Honeywell into the market, that represent a shift toward a more services-oriented and rather than exclusively equipment-oriented approach. The goal of the Compressed Air Challenge, described in detail in the next section, is to facilitate and accelerate this shift by providing extensive independent sources of information and training that the market currently lacks.

It should also be noted that inefficient industrial compressed air systems are not just an American phenomenon. From discussions and materials shared with my colleagues in Canada, the United Kingdom, the Netherlands, and India, industrial compressed air systems seem to be oversized or poorly operated on a global basis. Some outstanding work is being done, particularly by ETSU in the UK, to develop industry case studies that illustrate some of the benefits to be derived from a systems approach to compressed air. The Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET) recently published a brochure on compressed air system improvement opportunities for OECD countries (CADDET 1997). There is also some anecdotal evidence that customers in countries where production is being constrained by the electricity supply have a greater interest in energy efficient components, but it does not necessarily follow that their systems are more efficient overall.

5.3 Why doesn't the market "transform" itself?

As previously discussed, this market is already undergoing a gradual transformation. The question isn't whether the market can transform itself, the question is how and when this will be accomplished. Despite isolated cases of customer demand driving change, the average US corporate customer is ignorant of the possible benefits from improving the operation of their compressed air system. As long as production needs are being met, however marginally, the few plant operations staff remaining in most plants simply have no time to speculate about how the situation might be improved. In addition, there is a significant "face-saving" element to be considered. Motor Challenge has experienced some difficulty soliciting companies to participate as compressed air system case studies in part because the savings from "no-brainer" improvements are so large that the plant staff do not want it

publicized. Every experienced consultant in the business has at least one story of a customer who failed to implement suggested changes after spending thousands on a system assessment because they: couldn't believe the savings, didn't want to explain to their boss that they had purchased unnecessary equipment, or were reluctant to make changes for fear of a negative impact on production.

A deep lack of trust among the stakeholders has made it extremely difficult for manufacturers and distributors to change the way that they interact with customers for fear of being undercut. It is an atmosphere where an outside intervention is helpful so that no single stakeholder has to be the one who blinks first. Changing the situation requires the creation of a new market, a distributor/manufacturer focus on system opportunities rather than equipment solutions. It is a high-risk change that requires a complete re-evaluation of what constitutes a successful customer relationship coupled with an intensive re-education of consumers on the value of this approach. Providing an independent source of consumer information is an essential element of this change.

6.0 Case Study: The Compressed Air Challenge

This section will present the Compressed Air Challenge as a case study of a market-based intervention in which the federal government is acting as a *catalyst* working with market forces rather than as a regulator trying to control them. This case study will include the following elements: an analysis of the history, goals, and objectives of the Challenge; a description of the target market; use of a business approach in soliciting voluntary participation; the role of champions; progress to date; barriers; how effectiveness will be measured; and factors that are likely to contribute to its success. A brief discussion of likely outcomes, including unintended ones, will conclude this section.

6.1 Getting Started

The Compressed Air Challenge is outgrowth of work on Industry Partnerships for the USDOE Motor Challenge Program. The themes which ultimately led to this project were first identified in the April 1995 Roundtable on Market Transformation Strategies for Industrial Motor Systems breakout session on compressed air systems. The following needs were identified:

- make available technical information and training for many end users on how to operate their systems efficiently;
- reduce confusion over comparing efficiency ratings from different manufacturers;
- increase the consistency and availability of plant energy audits;
- create information about stakeholders and services;
- prepare case studies of cost savings and performance improvement;
- create a customer awareness program (prepare them to ask the right questions);
- prepare "boilerplate" purchasing specifications; and
- develop plant distribution guidelines.

A general point of consensus established at the Roundtable was that the major improvement opportunities are in the compressed air system, not the individual components.

Subsequent to the Roundtable, I began working with the Compressed Air and Gas Institute (CAGI) to identify cooperative projects that addressed some of these needs. Over the next twelve months, CAGI proposed two major activities:

- develop data sheets standardized reporting of performance for rotary screw compressors and two types of compressed air dryers; and
- develop a training and certification program on compressed air system best practices (Correspondence with CAGI Energy Awareness Committee 1996).

Work on a standardized format for reporting equipment performance is well underway. CAGI has made a commitment to complete the reporting format by the first quarter of 1998 and to begin posting equipment performance information on their web site using this reporting format. Third-party verification equipment performance is also under

consideration (Gault, Perry 1997). In addition, Motor Challenge has developed an informational publication on compressed air systems, including a resource directory. The resulting document *"Improving Compressed Air System Performance: A Sourcebook for Industry"* has received substantial input from participants in the Compressed Air Challenge and was published jointly by Motor Challenge and the Compressed Air Challenge in January 1998. The other major proposed CAGI/Motor Challenge effort- to develop a training and certification program on compressed air system best practices- led to the Compressed Air Challenge.

The first proposal for a training and certification program evolved from an informal session on industrial compressed air hosted by Neal Elliott of ACEEE and myself at the 1997 ACEEE Summer Study. We presented several possible activities in the area of industrial compressed air systems- a proposal to develop a training and certification program seemed to have significant appeal. Together with Mark Hanson of the Energy Center of Wisconsin (ECW), a session participant, and later Ron Wroblewski of ECW, we put together a concept proposal that focused primarily on training and certification of compressed air system consultants and awareness building.

6.2 Use of a Business Model

From its inception, the project model was to solicit multiple sponsors from market stakeholders with the objective of pooling funds to complete project deliverables. This approach was taken for two reasons: cost and developing ownership for implementation. The project was too extensive and costly for a single sponsor (or CAGI and DOE together) to undertake. Given the level of conflict and distrust in the industry, it was also critically important to build ownership and a new network of relationships during the development phase of the project. In my view, these networks of relationships are at least as important an outcome as the materials and training produced by the Challenge. Since the ultimate goal of the Challenge is to change market interactions and stakeholder behavior, those stakeholders (manufacturers, consultants, end users, distributors, state organizations, utilities) needed to become part of the process early on so that they didn't become unwilling recipients of someone else's idea of what is "good for them." The Challenge intends to have a major impact on the way that manufacturers, consultants, end users, and distributors do business. Project objectives need to be clearly stated, openly arrived at, and customer-tested to achieve maximum effectiveness.

The concept model included pooling of sponsor funds and stakeholder technical knowledge for basic materials development and then making these materials available to each sponsor to deliver to their customers either individually or in partnership with others. In this way, we also hoped to make the project more appealing to newly-competitive utilities seeking market differentiation.

After a number of stakeholder meetings over seven months with state research and development organizations, utilities, CAGI, and other interested parties, the concept piece

was substantially revised and recast as a prospectus for potential sponsors. The prospectus approach was used because we were seeking a combination of private, public, and not-for-profit sponsorship. We were concerned that a "government proposal" approach would alienate potential sponsors by not clearly and succinctly addressing the key question "what's in it for me?" The prospectus approach has been very well-received and greatly assisted us in defining the project (See Attachment A for a copy of the final prospectus).

6.3 Project Formation

One final stakeholders meeting was held in May 1997 to review the draft prospectus and try to reach consensus on a fundable project. Meeting attendees included: representatives from equipment manufacturers and distributors, compressed air system consultants, state and federal government, utilities, energy efficiency organizations, state research and development organizations, and a utility ESCO. Many of the attendees brought opposing agendas to the meeting and, in some cases, substantial distrust based on previous skirmishes in this highly competitive market. End user companies were purposely excluded from the meeting so that the other stakeholders would not be distracted by key customer relationships.

One major outcome of the meeting was that some of the stakeholders had the opportunity to meet each other for the first time. Another major outcome was a shift in project focus from training and certification of compressed air system consultants to doing the same for plant operating personnel. This shift occurred because the participants felt that it was much more doable as a first effort, since it avoided the issue of professional licensure. The group reached a consensus on a project that focused on three primary elements:

- a customer awareness campaign on the benefits of effective and efficient industrial compressed air systems;
- a nationally recognized professional development program to train plant operating personnel on compressed air system best practices, and
- a certification program for plant operating personnel who apply these best practices.

The group also made some key organizational decisions: that the project sponsors would each be asked to contribute $30,000 and would comprise an Advisory Board with final decisions for the project. Another body, initially described as Steering Committee and later named the Project Development Committee, would represent a cross-section of stakeholders, whether or not they were sponsors. This would permit participation and critical technical input by key stakeholders, such as the compressed air system consultants, who would be unlikely to commit $30,000 of their own funds. The Committee would be responsible for the overall operation of the project, in cooperation with the Project Manager. An Interim Steering Committee was formed to meet and prepare some recommendations in advance of the first Board meeting. The group decided that the Board would meet when sufficient sponsorship commitments ($300,000) had been obtained for the project to move forward.

6.4 Goals and Objectives, Target Market

A national collaborative, the Compressed Air Challenge, has been created to assemble state of the art information on compressed air systems design, performance, and assessment procedures. The purpose of the collaborative is to deliver best-practice compressed air system information to the plant floor, create a consistent national market message that supports the application of these best practices, provide a technically sound and professionally delivered training program for plant operating personnel, and through a certification program, recognize plant personnel skills in operating compressed air systems. These activities will:

- Increase the reliability and quality of industrial production processes,
- Reduce plant operating costs,
- Expand the market for high quality compressed air services, and
- Save energy; a 10% improvement over current usage would result in annual savings of more than 3 billion kWh of electricity nationwide

The target market for a comprehensive customer awareness campaign is:

- in-plant maintenance and operations staff,
- corporate engineering staff,
- plant managers,
- company CEOs/CFOs,
- equipment and service distributors/vendors, and
- utility companies.

The target market for the professional development program on best practices for improving and maintaining the efficiency of compressed air systems consists primarily of industrial plant operating personnel and maintenance staff.

The target market for the certification program consists of plant operating personnel with possible later expansion to compressed air system designers and consultants and their professional associations. A secondary market may exist with educational institutions providing preparation for graduate engineers.

6.5 Securing Sponsorships

Use of a business approach in soliciting voluntary participation set the tone for project fundraising. The theme stressed with potential sponsors was value- getting a $300,000 project for a $30,000 investment, having unprecedented access to the leading national experts in compressed air systems, participating in a project that was endorsed by USDOE, having control over introducing the products and materials to their customer base, obtaining national recognition for sponsorship support. I was personally involved in the fundraising effort. During the period from July 1 to September 10, 1997, a total of nine sponsors made a commitment to the project. By December 1, all ten sponsors were on board and three additional sponsors have since been added (See Attachment B). By mutual agreement outlined at the stakeholders' meeting in May 1997, we set certain parameters around the fundraising: in-kind contributions would not be accepted in lieu of a cash contribution; end users would not be asked to sponsor because we would be asking for substantial investments

of resources from them during the implementation phase of training; the equipment manufacturers would be asked to participate as a single sponsor through CAGI, so as not to dominate the Board. We expected the Board to dominated by utilities, but it didn't turn out that way, primarily due to the restructuring issues previously mentioned. The Board now includes: three state research and development organizations, four utilities/utility consortia, three equipment manufacturers and distributors' associations, an individual company that markets controls and system audits, a utility ESCO, and USDOE. It is interesting to note that the addition of a utility and a utility ESCO has stimulated some equipment manufacturers and distributors to consider applying for additional sponsorship seats to protect their business interests.

6.6 Progress to Date

The Compressed Air Challenge has made significant progress since its formation in September 1997. The first few months of the Challenge were dedicated to creating a workable organizational structure- which is still evolving and refining itself (See Figure 2). At the first Board meeting, several key decisions were made. These included:

- selection of the Energy Center of Wisconsin as the Project Manager;
- a decision not to incorporate the Challenge, but rather to define the relationship between ECW and the Board in a series of resolutions issued by the ECW Advisory Board;
- creation of a Project Development Committee to steer the project. Committee seats were established and most were filled by the Board at this first meeting;
- authorization for the Project Development Committee to move forward in cooperation with the Project Manager to define tasks and establish working groups;
- defining a framework for honoring intellectual property rights for existing materials used by the Challenge in its training and customer awareness activities;
- authorization for USDOE to proceed with planning a "kickoff event" to recognize the sponsors, and
- authorization for the Project Development Committee to work with Motor Challenge contractors to develop a name and logo for the Challenge (known at this point as "the Initiative").

For a complete summary of this initial Advisory Board meeting, see Attachment D.

Since the initial Board meeting, the Project Development Committee and the Board have met three times and monthly conference calls have been held. The Project Development Committee is now fully populated, with the possible exception of a future seat for end use equipment manufacturers, once these players are more fully engaged. See the program brochure (Attachment B) for a listing of stakeholder groups represented on the Committee.

Insert Figure 2 Here

Other actions by the Challenge include: creating the program logo and brochure, co-publishing with USDOE's Motor Challenge "Improving Compressed Air System Performance: A Sourcebook for Industry", creating a Challenge contact line at ECW, participating in the Compressed Air Challenge Kickoff on January 13 in Washington, DC, and commencing work on the technical content of the project.

The Challenge plans to have a 1-day awareness training workshop for plant operating personnel and a 2-1/2 day in-depth training for distributors, manufacturers' representatives, and utility representatives available for testing at five pilot sites by January 1999. The purpose of the longer training for distributors, manufacturers' representatives, and utility representatives is to prepare them to provide future training for end use customers. All instructors will be independently qualified and paid to ensure that the training remains product neutral. The customer awareness campaign materials will be developed concurrently and used to promote these pilot sites. Once the pilot sites have been evaluated, a full-scale roll-out of the Challenge training and customer awareness activities is planned for calendar 1999. Once the awareness training is underway, a more intensive, multi-day, modular training program for plant operating personnel is anticipated for roll-out in late 1999.

For a project of this type, the Challenge is moving very quickly. The Board made an initial decision to meet a minimum of two times per year, but has responded to the pace by scheduling meetings every two-three months during the critical development period. The half-time position originally envisioned for the Project Manager has expanded into a full-time administrative staffer and a half-time manager. In addition, I have remained more involved in the project than originally envisioned, primarily to manage the politics. As the Challenge has attracted more funding, the Board will be considering reallocation of funds to support project management, meet the expanded training mission, develop more extensive marketing, and compensate key individuals for travel expenses.

6.7 Potential Obstacles

The potential obstacles to the continued success of the Challenge are significant and should not be underestimated.

First, there is a constant tension during project development between the need to assemble small groups empowered to draft materials so that the project can proceed, and the need to keep the process open so that everyone who wants to participate gets the opportunity. As an example, the role of Board members at the working group level was a recent issue for discussion. During the development phase of the Challenge, a persistent problem is dealing with individuals and companies who are attracted to the Challenge as a marketing opportunity but lack the expertise to actively contribute. During the development phase of the project, it is important to protect end users and consultants (who often bring in their most valued end use customers) from unwanted solicitations for products and services. These people are volunteering their time and expertise for a specific purpose. The issue is one of

timing rather than exclusion- there will plenty of opportunities for all to interact during the implementation phase of the project.

Another potential obstacle that will have to be addressed is the issue of oversized systems. This issue strikes at the heart of the equipment business. If the Challenge message successfully reaches its target audience, there will be a shift away from large equipment purchases and toward smaller equipment coupled with comprehensive services. This will require some major changes in the way that manufacturers and distributors interact with their customers. Since the associations for distributors and manufacturers represent companies that will respond to these changes with varying degrees of success, pressure from these sponsors in outlying years of the project is anticipated. The continued active involvement of distributors, in particular, is extremely important.

Third, the Challenge is a very ambitious undertaking that requires a great deal from its participants. There is a real danger that the initial enthusiasm that has resulted in an unprecedented outpouring of volunteerism will exhaust itself before the project has reached its stated objectives. While steps are being taken to compensate for some of the costs of participation, the time invested is typically the primary issue for committee members and active members of working groups. We are looking for ways to keep the communication and the project activities flowing while making the most effective use of this precious resource.

Finally, it is simply very difficult to work the politics. As previously stated, this is an industry with significant trust issues coupled with honest differences of opinion on technical issues. Forming consensus across conflicting agendas can be very challenging and requires daily attention.

6.8 Measuring Effectiveness

The first measure of success was whether enough sponsors agreed to contribute $30,000 apiece for the first year to develop a functional budget of $300,000. This goal has been exceeded- sponsorship currently stands at $390,000. The second measure of success was whether a Steering Committee and Board of Directors were successfully formed. Again, this has been achieved. A third measure of success will be whether a framework is developed for establishing Working Groups and whether all interested stakeholders are able to find a voice in the Groups. Work on this is progressing. A baseline for evaluating the program will stem from two primary sources: a 1998 market study conducted by the Compressed Air Challenge and a recently completed study of industrial motor system applications conducted by Motor Challenge. Strategies are still being developed for assessing program impact, but will most likely include: training evaluation forms, post-training follow-up surveys, and feedback from consultants, distributors, and end users.

6.9 The Importance of Champions

The early part of my work with CAGI and with other market stakeholders included a lot of what could best be described as "hanging out"- going to meetings; making presentations; participating in numerous breakfast, lunch, and dinner meetings; visiting key people at their equipment manufacturing facilities. In the process, I logged a great many miles to see people on their own turf to find out where their interests were relative to compressed air systems. In this industry, which is small and highly specialized, many of the manufacturers and consultants have worked at more than one company. As a result, today's protégé or mentor may become tomorrow's fiercest competitor or critic. For an outside party to be an effective facilitator in such a charged environment, they must first be accepted by the industry. In my view, there is no substitute for personal interaction in building that trust.

A major result of this work was the identification of champions- representatives from each stakeholder group who were really willing to take risks to support and persuade others to support the Challenge. These representatives included: manufacturers, consultants, distributors, directors of state R&D organizations and a facility engineering association, and representatives from national energy efficiency organizations. Without them and the influence that they wield among their peers, the project would not have come to fruition. Many of them have also already invested huge amounts of their personal time and company resources in attending meetings, reviewing information, and drafting materials for the Challenge. The level of volunteerism in this project continues to be a revelation and, in my experience, unprecedented.

In recognition of the importance of the "people side" of the equation, one of the first public actions of the Compressed Air Challenge was a DOE-hosted event to celebrate the project kickoff and the people who made it possible (See Attachment C- Kickoff Press Release). The prospect of early and regular recognition by USDOE was an important selling point in fundraising efforts.

6.10 Factors Contributing to Success

If early indications hold true, the Compressed Air Challenge is likely to attain its stated goals for market change and resulting energy savings. While constant maintenance is still needed to ensure that the participants focus on and continue to refine a shared vision, the collective commitment of so many important market shareholders has created its own forward momentum. The quality of meetings at all levels of the Challenge are an example of this excitement. As work progresses and the potential for change becomes evident, individuals with differing points of view have become more engaged and active. At the same time, there is a great deal of mutual respect. Participants seem willing to compromise, even over hotly-contested issues and closely-guarded positions of genuine disagreement, in the interest of project progress. A sense of needing not to fail or to be seen as obstructionist among peers seems to have superseded personal agendas, however temporarily. As long as key players are

given the opportunity to be heard, the result is a very fast-track project with a broad base of support.

The biggest challenge is maintaining a balance between developing an independent body of information for the public good and the commercial interests of those involved in its development and delivery. The federal government can be very effective in helping to maintain this balance.

I think that the following factors may be contributing to the success of this project:

- the supply side of the industry has exhausted itself through hypercompetition (Porter and van der Linde 1995) and is ready for change. Market influencers such as the investor-owned utilities and the compressed air controls industry are looking for business opportunities and threatening the status quo. The Challenge offers an opportunity for equipment manufacturers and distributors to look like good corporate citizens while keeping abreast of and influencing new market developments;
- utilities and utility consortia are looking for market transformation projects of manageable length and investment. The Challenge gives them a quality product for their critically important industrial customers at a highly leveraged bargain rate.
- the Challenge itself is structured so that the sponsors can share rights, form partnerships of their choice to deliver the resulting products and materials, and take credit for sponsorship;
- all non-governmental sponsors have indicated that association with the DOE is a critically important public relations and marketing factor;
- the compressed air end user is invited to participate in development as well as delivery of the resulting training, materials, etc. Participation is structured so that it is compatible with the demands of their work environment;
- there is already a strong base of quality technical information from which to draw; it requires consolidation and re-packaging; and
- by working through representative associations, input from the universe of interested parties can be managed.

6.11 Other Possible Outcomes

One other possible outcome is the creation of an effective professional association to represent independent compressed air system consultants. This outcome may have been launched as the result of a meeting sponsored by the Challenge in July 1997. Given the fragmentation of the consultant community, this result would be remarkable.

A second possible outcome is the development of a process to continually add to the public body of knowledge on efficient operation of compressed air systems. Currently, this information is only accessible to a few individuals and companies who have actively sought it out. If the Challenge developed sufficient momentum, coalitions of important market influencers could be formed that persist beyond the initial project and provide a forum for this to occur.

A third possible outcome is that the activities undertaken by the Challenge will have a consolidating effect on the compressed air industry. As customers become more demanding of quality service, companies that market equipment and services will seek partnerships and undergo mergers to more effectively meet their customers' needs. As a result of recent Challenge actions, the Compressed Air and Gas Institute has already taken under consideration the possibility of inviting controls manufacturers into the trade group.

A fourth possible outcome is that one or two ESCOs will aggressively enter the compressed air services market to take advantage of the increase in customer awareness. This is already happening- it will be interesting to see how strongly these ESCOs link their activities to the Compressed Air Challenge message.

A fifth possible outcome is that the participants that are brought together through this process will identify other common areas of interest which are entirely outside of the initial project scope. Already, a number of business alliances have been formed as the result time spent by Challenge participants working on joint projects.

7.0 How to Apply the Collaborative Model

Successful application of the collaborative model requires that the target market is well understood and that there is a possibility for change. The following key characteristics describe the environment in which the federal government can have an effective facilitating role.

7.1 Key Characteristics of a Successful Collaborative Intervention

Careful selection of a target market is imperative to the success of a collaborative intervention. Elements of a suitable target market include:

- a significant energy efficiency, environmental, or other public benefit opportunity- or a collection of related benefits such as increased productivity, cost savings, enhanced safety or health benefits, commercial viability, improved comfort, or other desirable traits;
- the potential for a commercial interest to assist customers in taking advantage of the opportunity, through the provision of goods and services;
- a market of manageable size- as mentioned previously, it is important that key stakeholders or their representatives are able to meet to exchange ideas;
- the ability to identify a broad range of market stakeholders;
- a market that is either under pressure to change or just beginning to change;
- the presence of potential champions- people who are dissatisfied with the status quo; and
- the availability of an effective facilitator to act on behalf of the federal government.

Missing from this list is something that the federal government frequently seeks out-- a market that is initially receptive to partnership or already known to the government in some way. In my view, this is an overrated characteristic. It would have been difficult to identify a market that was initially less known or perceived to be more resistant to a government partnership than the compressed air industry. This is a very tightly-held, highly competitive industry with virtually no previous experience working with the public sector outside of the Internal Revenue Service and the occasional anti-trust threat. A compelling characteristic of the market was pervasive mistrust- among manufacturers, distributors, consultants, and the customers that they served. It is important to recognize that initial conflict is an indicator that something of value is at stake- perhaps a transformation opportunity worth further examination.

We began from a position of mutual but vaguely held suspicion and considerable curiosity. After an initial period of building trust, this lack of experience became an asset for the market-based intervention- the market had few preconceived notions of what was possible, so the ideas and solutions were more forthcoming and creative than they might otherwise have been.

Insert Figure 3

7.2 Creating an effective federal role

The role of the federal government has been critically important in the progress made to date. As previously noted, the industrial compressed air system market is undergoing a slow transition from equipment solutions to a system services approach. However, the average corporate customer is ignorant of the possible benefits from improving the operation of their compressed air system. The federal government is in a unique position to encourage champions for change across the entire stakeholder spectrum, thus accelerating this transition while still working within market structures. Federal involvement can provide positive identification for suppliers and end users by publicly recognizing them as forward-thinking companies supporting sustainability and environmental benefits. Federal involvement can also be used by would-be champions to build their own position within their organizations through the subtle implication that failure to "get ahead of the curve" could result in either lack of competitiveness or even future regulation.

It is important to recognize that this approach requires a different way of doing business for the federal government. The first requirement is tolerance of ambiguity and loss of control. The kiss of death for a market-based approach is the failure to listen- *really* listen- to the desires, interests, ideas, and agendas of the various market stakeholders. Acknowledging publicly the skills, knowledge, and talent of people who have spent their entire careers in a specialized field is critically important. Ideally, the federal facilitator will begin the exercise as if it were a journey of mutual exploration- the stakeholders getting to know each other at a different level- stakeholders educating the federal facilitator on how the market works, the facilitator giving very general examples of the types of things that government can do, and everyone deciding jointly on areas of mutual interest. It is a true partnership- no one, including the federal government, should bring out their wallet until the project has been adequately defined- and then all should invest equally. This process takes a great deal of time to develop. Personal presence and attention to details matter- little things, like the Beltway convention of spelling "federal" beginning with a capital letter or using government jargon, can convey arrogance, however unintended.

A second requirement involves the authority invested in the facilitator. As the facilitator acting on behalf of USDOE for this project, I am speaking from personal experience. The facilitator must be free to act within pre-established boundaries without soliciting additional bureaucratic approval. If it is effective, development of a market-based intervention will frequently range "outside the box" of what would be construed as a typical government program activity. The goal of the facilitator must be to blend as much as possible with the industry stakeholders in order to really understand what is needed. This means that it is probably more effective if the facilitator is not a federal employee but close enough to the acting government agency to be accepted by others as a trusted representative. Federal line-of-command staff are generally expected to respond to internally-driven needs of the bureaucracy (reporting, meetings, budget discussions) which can detract from the effort. Supervising agency staff need to buy into the project goals and allow the facilitator a great deal of freedom to experiment within pre-established parameters. Failure to do this will result in either project failure, as participants learn that the facilitator lacks the authority to negotiate, or in a

confrontational, "Grant at the siege of Vicksburg" approach in which the facilitator seeks later forgiveness rather than approval[5].

The third requirement for the federal government is patience. For the Compressed Air Challenge, the first two years were preparatory and the third year was dedicated to project formation. It was only during the last quarter of the third year of activity that the project really took off. It will be nearly four years from the first exploratory discussions before the primary "product"- training of plant operating personnel- really gets underway. While this type of timeline is acceptable for federal funding of technical research, it is not typical of so-called "applied program" activities in the energy efficiency field. These types of activities are more likely to be subjected to pressure for an outcome within a single budget cycle. This is simply not enough time to do anything meaningful in a collaborative intervention. The facilitator must become known and trusted with the market(s) that he/she is attempting to influence, which usually will require more than a year, before anything can even be planned.

In my view, it would be more appropriate to think of this type of activity as "organizational or behavioral market research" that creates an environment for an applied program activity to take place. It has all the hallmarks of research- a stated problem, many possible solutions, and the need for substantial analysis to test and determine what will be effective. The difference is that the issues relate to desired changes in human and organizational behavior rather than new technologies. What is being created as the result of the Compressed Air Challenge is a new virtual organization that didn't exist before- a forum for information exchange and the creation of joint products and materials- to support an emerging market for services. It is a work in progress that is being shaped by the stakeholders who are being asked to take real business risks and need corresponding assurances from the federal government that they aren't going to be abandoned mid-change due to some institutional or political whim. While the environment for change is being created, the federal facilitator must also satisfy institutional and political needs by regularly communicating project goals and progress.

In short, what a collaborative intervention requires of the federal government is respect for a businesslike approach. This needs to be reflected in the language used; the way that the project is organized; the time commitment; the conduct of meetings (focused, substantive, start and end on time); the responsiveness, authority, and professionalism of the facilitator and his/her availability for the occasional evening or weekend presentation or meeting. As previously mentioned, the use of a business prospectus rather than a government proposal approach to project definition and fund

[5] During the Civil War, General Grant had his troops cut the telegraph wires so that he had no communication with Washington while he was trying to break the protracted standoff and seize Vicksburg for the Union. He succeeded.

raising has proven to be very successful. For the Challenge, it also helped establish a "we mean business" appearance by clearly outlining the value and opportunity for prospective participants.

7.3 Transferring the Model

I have recently been asked to employ a similar approach for a market-based intervention to promote a systems approach in the industrial pumping industry. I plan to use the key characteristics identified in the previous section. Like air compressors, pumps are typically commodity purchases and are rarely sold as part of a system. However, important differences exist between the compressed air system and pumping markets.

The equipment technology is mature, operation is fairly straightforward, and standards are well-established. The energy savings opportunities from looking at the system have already been documented through the Motor Challenge program. The dynamics of distrust and technical disagreement that characterize the compressed air industry are not as prevalent. Pump purchases are typically less costly per unit and are much more frequent per customer than air compressor purchases. There are also many more manufacturers of pumps. Consequently, I expect that the process of engagement for an initiative in this industry will be quite different and will likely concentrate on a subset of the industrial pumping market, as yet to be identified. With equipment standards already in place, a focus on systems would be a logical next step, but the commercial benefit will need to be clearly outlined after substantial discussion with industry insiders, since margins per system are likely to be relatively small. Again, the key is to let the industry stakeholders guide the discussion and educate the federal facilitator about the industry before any plans are mutually developed.

In closing, I would like to stress that the market-based approach has substantial promise for other markets, including the commercial building sector. It is an extremely cost-effective way for the federal government to effect lasting change within markets, because shifts in behavior create a dynamic that will provide for continued change long after the initial intervention has been completed. By explicitly acknowledging that all permanent market changes are ultimately dependent on changes in human and organizational behavior, this approach also creates an environment for the effective introduction of technological innovation. While I have not conducted a cost-benefits analysis, I assume that market-based intervention would compare quite favorably to a regulatory approach and exceed the cost-effectiveness of demand side management approaches. It is also an approach that is sustainable because it respects the workings of the marketplace.

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Figure 2

Compressed Air Challenge Organizational Structure

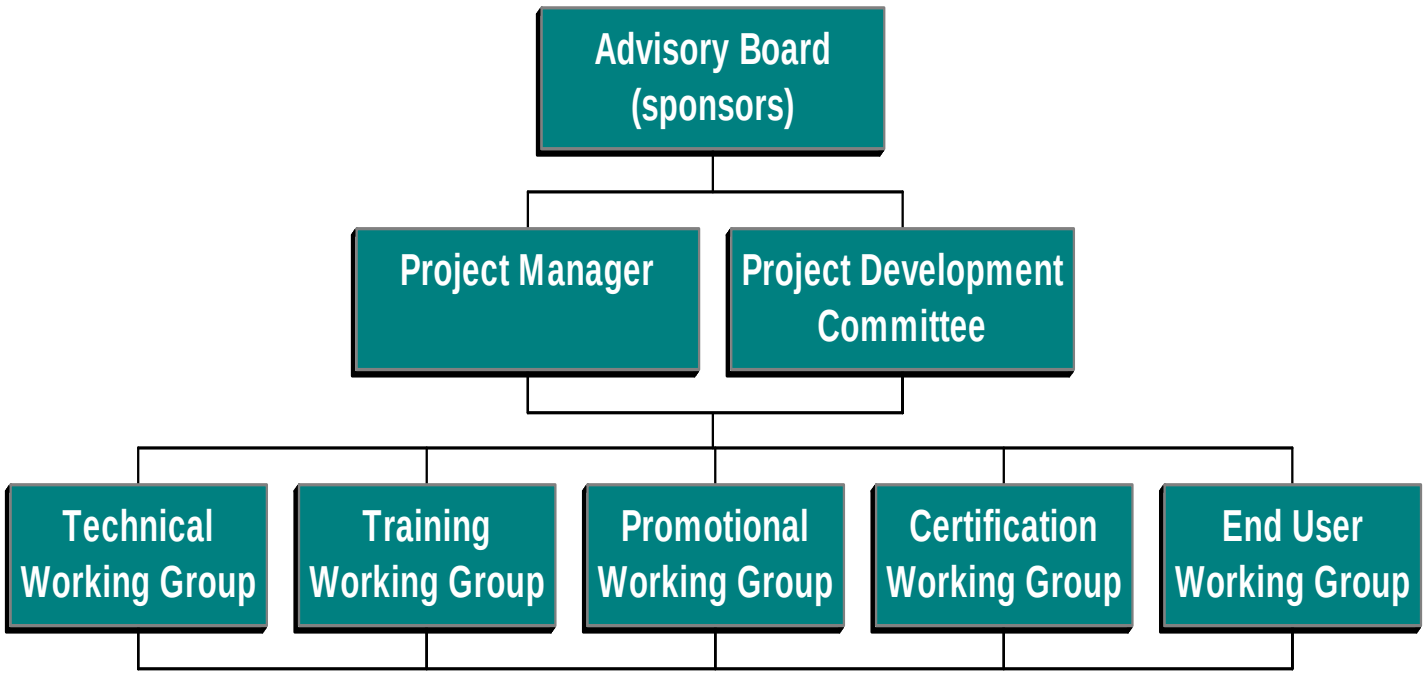

Figure 3

Elements of a Collaborative Intervention